THE current

RESEARCH AND HAPPENINGS FROM RHODE ISLAND EPSCoR | INAUGURAL ISSUE

What is EPSCoR?

NSF RI EPSCoR

THE current

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Greetings From The Directors

RI EPSCoR (The Rhode Island Experimental Program to Stimulate Competitive Research) is pleased to introduce the inaugural issue of its newsletter, "The Current." In it, we will introduce you to RI EPSCoR's history, its research and education initiatives, and the progress that has been made since the program's inception in 2006.

The articles in this issue answer the question, "What is EPSCoR?" In general terms: EPSCoR is an experimental federal program that works towards leveling the playing field in research and development across the United States. RI EPSCoR builds research infrastructure capacity by establishing statewide centers of excellence to promote collaboration, increases the quality and number of science education opportunities and drives research-based economic development within Rhode Island.

RI EPSCoR is still in its infancy, and we are very proud that the past two-and-a-half short years of National Science Foundation funding have been incredibly productive. Entering the third and final year of our $6.75 million Research Infrastructure Improvement grant from the NSF, RI EPSCoR is showing no signs of slowing down. Research Core Facilities in Genomics, Proteomics and Marine Life Sciences have been established and are providing state-of-the-art infrastructure and training to researchers and students. Several faculty scientists, such as Dr. David Rand of Brown University (see page 4), regularly take advantage of all three core facilities.

The Genomics and Sequencing Center has run almost 10,000 samples in 2008 from 10 departments at URI, Brown, Rhode Island College, Roger Williams University, The American Museum of Natural History in New York and the Woodland Park Zoo in Seattle. The new Proteomics Core at Brown has over 2,200 machine-hours logged this year, and its equipment has been used by 20 scientists from Brown, Providence College, Rhode Island Hospital, URI and Women and Infants Hospital. The flowing seawater facility at the Center for Excellence in Marine Life Sciences currently houses 12 URI

In 1978, the National Science Foundation founded the Experimental Program to Stimulate Competitive Research (EPSCoR). EPSCoR stimulates sustainable improvements in academic science and technology infrastructure in states that receive low levels of NSF research funds. These investments create a foundation for economic growth based on science and technology. Several other agencies have also developed EPSCoR or EPSCoR-like programs.

faculty and graduate student experiments and has in the past housed projects from Brown, the University of Hawaii, the University of California and the University of Maine.

The RI EPSCoR Academy, the clearinghouse for all student and faculty training opportunities, is up and running. One of the RI EPSCoR Academy's mandates is to catalyze programs that integrate research and education and stimulate the Science, Technology, Engineering and Mathematics (STEM) pipeline. Towards those goals RI EPSCoR recently facilitated a $12.5 million NSF Math and Science Partnership grant to enhance K-12 STEM education. This capacity for coordination led to collaboration with the RI IDeA Network of Biomedical Research Excellence (INBRE) to support over 40 students in the Summer Undergraduate Research Fellowship (SURF) program. This past summer's SURF program concluded with a scientific poster conference that highlighted over 80 undergraduate projects from across the state (see page 9).

An important component of EPSCoR is recruiting minority students and faculty, something we have been working on with The Leadership Alliance at Brown. For the first time, the Alliance extended some of their summer activities to our SURF students as a special opportunity to promote collaboration and increase the strength of both programs in the state. The Northeast Louis Stokes Alliance for Minority Participation (LSAMP), a consortium of New England universities committed to increasing the number of underrepresented students participating in the fields of science, technology, engineering and mathematics, is a growing partner of the RI EPSCoR Academy. We worked together this year to deliver a weeklong marine science academy to minority high school students.

In the past 2 ½ years, EPSCoR has supported 18 graduate students at URI and Brown. Their outstanding research is a huge asset not just to their faculty advisors, but also to our program and the local research community. Several of the graduate students presented their research at the 2008 Rhode Island Research Alliance Symposium this summer, while others attended poster conferences nationwide.

With the leadership of the RI Science and Technology Advisory Council (STAC), RI EPSCoR has met many of its initial goals. The program's excellent leadership and support staff share a common vision and passion that drives life sciences innovation and partnerships statewide.

We especially wish to thank the researchers, educators, industry partners and government leaders who have made RI EPSCoR so successful. The payoffs of the program — research discovery, job creation, diversity enhancement, workforce and economic development — are worth many times NSF's initial investment.

We are proud of EPSCoR's success and what it has accomplished in its short lifetime. Coming years will see the maturation of the program through improved infrastructure, further collaboration and the continued education of the next generation of scientists. In these ways, the program will continue to serve as a valuable asset to the Rhode Island research and education community as well as the economy of the state as a whole.

Sincerely,

Dr. Jeff Seemann
RI EPSCoR Director
University of Rhode Island

Dr. Clyde Briant
RI EPSCoR Co-Director
Brown University

ABOUT RI EPSCoR

RI EPSCoR's mission is to create lasting improvement in Rhode Island's research infrastructure by advancing statewide innovation through strengthening Rhode Island's basic science and engineering research capacity and addressing Rhode Island's workforce needs using enhancement of science and engineering training and education for students.

ABOUT THE RI EPSCoR ACADEMY

The RI EPSCoR Academy fosters the integration of research, education, innovation and communication statewide. It works to (1) Develop the human capital necessary to support and sustain the growth of competitive research capacity in the life sciences (2) Broaden the participation of women and underrepresented ethnic and racial minorities in the STEM workforce and (3) Develop and maintain sustainable communication mechanisms to build and enhance a strong statewide network of the state's and region's scientists, institutions of higher education, and private and public sectors.

RI EPSCoR
Experimental Program to Stimulate Competitive Research

Three Facilities for Rhode Island's Scientific Future

Dr. David Rand, Brown University

EPSCoR has many areas of focus — collaboration, science education, economic development — but its primary mission is to create a statewide infrastructure to help scientists conduct new research more efficiently.

Part of EPSCoR's initial development established three "core" facilities — one each in proteomics, genomics, and marine life sciences — that offer the latest technologies and techniques to state researchers.

The facilities ensure rapid and equal access for the entire Rhode Island research community. And while many scientists and students use the facilities, following one scientist's use of them helps illustrate how they benefit life sciences research in the state.

Dr. David Rand, professor of Ecology and Evolutionary Biology at Brown University, studies evolutionary genetics, specifically how natural selection acts on genes and how different environments affect selection.

Rand and his colleagues study the impact of changes to the nuclear and mitochondrial genomes of organisms, especially the *Drosophila* fruit fly, to determine how these changes influence survival, reproduction, and other basic tests of evolutionary fitness.

They do this using the EPSCoR core facilities.

TESTING THE GENES

Perhaps the most important of the core facilities to Rand's work is the Rhode Island Genomics and Sequencing Center (RIGSC), at the University of Rhode Island, which provides cutting-edge technical and analytical support for molecular biology and genomics research.

RIGSC is key to Rand's studies because his tests manipulate *Drosophila* genomes, which can be assembled in constructs designed by the scientists. Once created, "you can then subject these assembled genetic constructs to a variety of tests: do they produce different proteins, do [the flies] live longer, do they jump higher?" says Rand.

Before RIGSC, Rand sent the materials for genotyping — mapping to determine an organism's genetic makeup — to labs in Washington and Texas, leading to higher costs and longer wait times for results. With RIGSC, results are processed faster and at a lower cost, while also keeping research dollars in-state.

NEEDED FACILITIES

Rhode Island's 400 miles of coastline aren't just enjoyed by tourists. They're also central to the study of marine and coastal ecosystems.

The second core facility — the Rhode Island Center for Excellence in Marine Life Sciences, based at the URI Graduate School of Oceanography (GSO) — assisted Rand and a graduate student in their research. The graduate student used the center's modern flow-through seawater facility in an experiment studying barnacle genetics.

The experiment, which observed the effects of temperature, salinity, and food supply changes on the genes of a barnacle common to the Narragansett Bay, couldn't have happened without the facilities and collaboration provided by EPSCoR, Rand said.

"Having access to this through the EPSCoR program was instrumental in letting us do this. Brown has no

flowing seawater facility," he said, noting that EPSCoR's facilitation of collaboration with other researchers, especially Ed Baker, manager of seawater facilities at the GSO, was crucial.

LOCAL PROTEOMICS

Just as the other two facilities offer new research opportunities and greater efficiencies, so does the Rhode Island Research Center for Proteomics, the third core facility.

"the presence of the three core facilities strengthens Rhode Island's national position in life sciences research"

Proteomics, the study of proteins' structure, function, and interaction, requires state-of-the-art equipment. The Proteomics Core, located at Brown, offers this equipment and backs it with fundamental research knowledge.

Thanks to its expert staff, "the resources are available to find out how the proteomes of [the organisms being studied] differ. That's something I don't know how to do," said Rand.

The facility also allows researchers to explore more avenues in their research with less concern for lost time or shipping expenses.

THE PROMISE OF COLLABORATION

The presence of the three core facilities strengthens Rhode Island's national position in life sciences research, said Rand.

"By putting these facilities in place and having people able to submit proposals that would work there, it will draw in and maintain researchers throughout the state that might not be there otherwise," he said.

Ultimately, though, "one of the best things that happened from the EPSCoR program … is that it has opened a line of communication [among schools in the state] that is very healthy" and will lead to greater local research success, he said.

By fostering collaboration and locating facilities at the state's leading research institutions, EPSCoR has helped researchers throughout Rhode Island, in Rand's words, discover that "there are people doing really cool things … that can work together."

explainer

WHAT IS GENOMICS?

Broadly defined, genomics is the study of genomes, where the word genome describes the sum total of all the genetic information that defines an organism, whether it be a virus or a humpback whale. The genome is composed of DNA, a long chain of four smaller building blocks called deoxyribonucleic acids that are arranged in defined sequences characteristic for each organism. Some sections of the DNA are designated as genes because they either encode for proteins or for other functionally important molecules such as small RNAs. Other regions, that make up the majority of genomic DNA, are non-coding, and these influence function and heredity in ways that are not yet well understood.

Genomics is often comparative, taking advantage of large public databases to explore relationships among regions of different genomes. Functional genomics goes beyond the use of these databases to study relationships and uses data generated from cutting edge technologies such as high throughput sequencing and microarrays to understand the function of genome regions. Functional genomics can also be used to compare sequences among different individuals within a species. Genetic variations among individuals can contribute to disease either directly or in conjunction with other factors such as environmental exposures. Other naturally occurring variations in human DNA sequence help explain why people can have very different responses to some drugs.

RI EPSCoR

Leading Rhode Island's

It is widely expected that the life sciences will be an area of great scientific and economic growth in the decades to come. With that in mind, a group of Rhode Island scientists, policymakers, educators and business leaders have been working together since 2004 to make the nation's smallest state a big player in life sciences. The result of this effort is Rhode Island EPSCoR.

Scientific Development

A HISTORY OF COLLABORATION

The National Science Foundation (NSF) established the Experimental Program to Stimulate Competitive Research (EPSCoR) in 1978 to better distribute federal funding for research and development to states that historically received less R&D support, such as Rhode Island.

Led by URI Dean Jeff Seemann, Rhode Island became an EPSCoR state in 2004. That initial $500,000 planning grant was followed in 2006 by the state's first NSF Research Infrastructure Improvement grant of $6.75 million, something important to both the academic and public sectors.

"The University of Rhode Island and the state of Rhode Island are very interested in advancing academic research capacity here within the state. It is an essential piece of economic development. It is an essential piece of job creation, of technology creation, of new company creation," said Dr. Seemann, the project director of RI EPSCoR.

But it's also expensive – often more expensive than a single scientist or institution can manage on their own. That's where RI EPSCoR comes in.

"In this time of limited resources and funding in the life sciences, it's extremely important for those institutions pursuing research in those areas to be as collaborative and cooperative as possible," said Dean Edward Hawrot of Brown University, who recently became co-project director with Seemann.

RI EPSCoR works with the RI Science and Technology Advisory Council (STAC) and the Rhode Island Research Alliance to effect sustainable improvements to local research infrastructure "that [create] the landscape for scientists to do cutting edge, competitively funded research," added Seemann.

EPSCoR's three goals

RI EPSCoR aims to bolster science in three key areas: research and development infrastructure capacity, science education and outreach, and economic development.

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"EPSCoR is an essential piece of job creation, of technology creation, of new company creation"

spotlight

Graduate Student: Stephanie Forschner

Graduate students are a vital bridge between two of the worlds that RI EPSCoR aims to integrate: research and education in the life sciences. To that end, EPSCoR has funded 18 graduate students in Rhode Island. Stephanie Forschner, of the University of Rhode Island, is one.

Stephanie Forschner

Originally from Leechburg, PA, Forschner is entering the fifth year of her graduate research at URI, where she also earned her undergraduate degree in Marine Biology. She works with Dr. David Rowley of the URI College of Pharmacy.

"Dr. Rowley is a very motivating advisor and his enthusiasm is contagious. He can make the most mundane task exciting," she said.

Forschner studies the toxic and non-toxic interactions of bacteria on marine organic particles in Narragansett Bay. Marine particles, also known as "marine snow", include once-living material such as detritus, dying algae blooms, fish scales and waste. They provide nutrient "hot spots" in the otherwise nutrient-limited water column. Space and food for these microorganisms is limited, especially given the speed of their reproduction, forcing them to protect their territory and better compete for resources using adaptations like toxic chemical warfare in the form of antibiotic production.

Still, "non-toxic chemical interactions occur at a higher rate than toxic interactions in the Bay," Forschner explains. "This could mean that non-toxic chemical interactions may be even more important in the community structure of bacteria on the particles." A component of her work involves the use of the EPSCoR-funded Genomics and Sequencing Center to identify particle-attached bacteria.

The structure of these communities has implications in the cycling of nutrients and the food web in Narragansett Bay. In addition, molecules that mediate interactions between microorganisms may have biomedical potential as antibiotics.

Forschner is an active participant in EPSCoR. This summer Forschner taught a SURF student in Dr. Rowley's lab molecular and genetic techniques such as extracting DNA and gene sequencing. At the SURF mixer, Forschner shared stories about her research cruise from Samoa to New Zealand where she studied Actinomycetes, a class of bacteria in deep-sea sediments, some of which produce biomedical compounds including antibiotic and anticancer agents.

Forschner presented her research from this project at the RI Research Alliance Symposium in June, along with two other EPSCoR graduate students.

"Wanting to stay in Rhode Island, I enjoyed this conference because I got to see what research was going on in-state. I got to identify the key players and also see the work of other organizations outside of academia such as the local hospitals. It was a great networking opportunity," she said.

Forschner is well on her way to receiving her Ph.D. from URI with Dr. Rowley and hopes to gain experience as a post-doctoral fellow before entering a biomedical research career.

As an active member of the state research community, and someone whose work benefits Rhode Island, Forschner is an EPSCoR success story.

"I have put down roots in Rhode Island," she said, "and would love to stay in the state should the opportunity present itself."

Students ride the science wave with SURF

Group of SURF students touring Dr. Albert Kausch's lab

In a state with as much coastline as Rhode Island, the word "surf" immediately conjures up thoughts of saltwater and wetsuits. But after a summer spent in a RI EPSCoR Academy program, 40 undergraduate science students from colleges throughout the state think of surf in a very different way.

The RI ESPCoR Academy, the education-outreach component of the program, aims to expand research capacity, workforce training and economic development in the life sciences. Two essential components of reaching these goals are the expansion of graduate programs in the STEM disciplines and increased undergraduate participation in research.

RI EPSCoR and Rhode Island IDeA Network for Biomedical Research Excellence (INBRE) collaborated in 2008 for the first time to place students in these settings through the Summer Undergraduate Research Fellowship Program (SURF).

"The opportunity of a lifetime"

LEARNING IN THE LABS

Under the guidance of faculty scientists, SURF student fellows in Biomedical Sciences, Genomics, Proteomics and Marine Life Sciences completed 10 weeks of research and participated in career-building workshops, presentations and trips, including:

- A visit to Pfizer pharmaceuticals' Nuclear Magnetic Resonance, Flavor and Obesity research labs in Groton, CT
- A tip-filled presentation about the graduate school application process by Dr. Harold Bibb from the URI Graduate School
- A video conference on "Global Sustainability & Your Career" by Dr. Barry Costa-Pierce, the director of RI Sea Grant, broadcast live to five participating institutions
- Tours by Dr. Albert Kausch of URI and Plant Advancements, Inc., and by Ed Booth and Myles Standish at Newport Biodiesel.

POSTERS HIGHLIGHT ADVANCES

The SURF program concluded with a poster conference at URI highlighting the research of over 80 undergraduates from URI, Brown, Providence College, Rhode Island College, Roger Williams University, the Community College of Rhode Island and Salve Regina University.

After an intensive training session led by Brianne Neptin of the URI Coastal Fellows Program, each student designed a poster to convey their scientific results and

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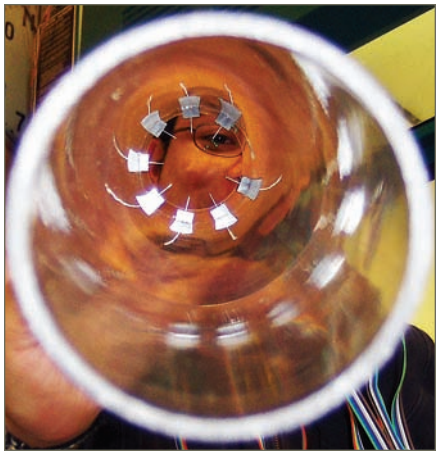
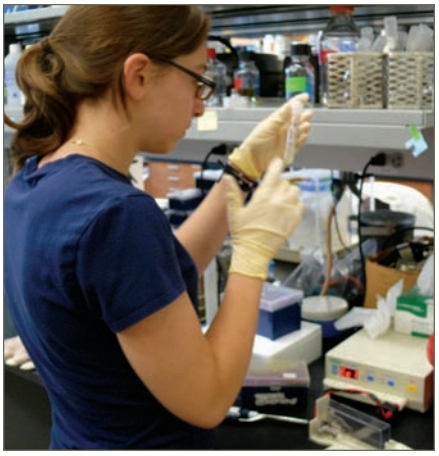
Yasah presenting her microbial fuel cell research



Fabian with his gas sensor prototype



Elizabeth performing a bacterial transformation

explained their projects when questioned during sessions.

Poster topics included cardiac development in zebrafish, selective estrogen receptor modulators and their role in the treatment and prevention of breast cancer, pathology involved in Crohn's Disease and mercury bioaccumulation in fish of Narragansett Bay. The research could lead to the development of antibiotics to battle quickly evolving pathogens, new techniques for detecting cancer biomarkers, and nanopore technology for more efficient and cheaper gene sequencing.

Many of the students expressed strong interest in continuing their research, demonstrating how SURF both generates novel scientific results and positively impacts the students' education and career goals.

UNPARALLELED OPPORTUNITIES

"The SURF program was a great opportunity for me to immerse myself in a research project," said program participant Danielle Perley of Roger Williams University. "It gave me the opportunity to develop a research plan and execute it."

Together with RWU professor Marcia Marston, Perley used genetic techniques to examine the diversity of cyanophage viruses of family Podoviridae, which were recently found in Narragansett Bay. The team discovered two new podoviruses in the Bay, which will lead to

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To enhance the state's existing research strengths in the life sciences and promote synergies, RI EPSCoR's comprehensive research infrastructure development strategy targets molecular, marine and environmental biosciences for growth.

By promoting institutional collaboration and establishing three core facilities in genomics, proteomics, and marine life sciences (see page 4), EPSCoR helps local researchers access the latest technologies and find opportunities for collaboration. It also supports researchers by connecting them to NSF and other agency funding opportunities (learn more at http://stac.ri.gov/epscor/funding).

"Scientists everywhere need to have the latest, best tools of their scientific profession to carry out cutting edge, fundable research," Seemann said.

RI EPSCoR's education and outreach component is centralized in the RI EPSCoR Academy, which provides educational and training opportunities to students and faculty in collaboration with likeminded partner programs (see page 9).

The RI EPSCoR Academy places a particular emphasis on "getting more kids more interested and more engaged in science and technology and making sure they're coming from more diverse backgrounds," said Seemann.

Lastly, EPSCoR uses new research and workforce education to promote economic development in the state, which can take the form of founding

a better understanding of the structure of viral communities of estuarine environments and help illuminate the way cyanophage/host interactions impact the cycling of carbon and nutrients.

Under the guidance of URI professor Otto Gregory, URI student Fabian Sierra worked with researchers at URI, Georgia Tech and Sensor Tech in Savannah, GA, to develop novel combinations of transition metal oxide catalysts for the detection of specific gas molecules of interest to the US Army and Department of Homeland Security. This project could lead to sensors able to detect minute quantities of hazardous gas without interference from background gases.

"The SURF program allowed me to grow as a student by giving me opportunities to be involved with college level research"

"The SURF program allowed me to grow as a student by giving me opportunities to be involved with college-level research. The various activities provided by the program gave me excellent advice on how to continue my career in the research field and opened my eyes to how many interesting and wonderful research projects students around the country are working on. Without a doubt this summer was the opportunity of a lifetime," said Sierra.

A BIGGER WAVE

The benefits of SURF are great. For the undergraduates, participation affords the opportunity to gain research skills, participate in professional development seminars and training, and gives them a chance to present their findings in a public format, all increasing students' competitiveness for research-based careers in the life sciences.

Rhode Island benefits broadly from SURF because the program helps develop and train the personnel necessary for the state to remain competitive in the global knowledge economy.

The collaboration of RI EPSCoR and RI INBRE in creating SURF has created an effective program to encourage undergraduate research in the life and marine sciences statewide. Both programs are eager to continue the SURF collaboration to give Rhode Island's undergraduates a bigger, more exciting science wave to ride.

new companies based on research breakthroughs or convincing existing companies to relocate thanks to Rhode Island's scientific and human resources.

"The hope would be that there would be commercial applications for some of the discoveries which could lead to new start-ups, companies forming in the state, leading to new jobs," said Hawrot.

LOOKING TO THE FUTURE

By all measures, RI EPSCoR has made substantial strides in its first two years.

"We're trying to do one thing very well and have it serve the needs of all the Rhode Island institutions of higher education, and I think we've been very successful at that," Seemann said.

In coming years, RI EPSCoR will continue to promote the integration of research and education and to engage government, industry and the state's 11 institutions of higher education, as well as facilitate proposals for EPSCoR agency funding.

In the near term, "the big thing will be focusing on more collaborative activities and beginning to reap the rewards," Seemann said. "We will see some great science being done."

Both Seemann and Hawrot agree that the achievements of the two years since RI EPSCoR's initial NSF grant are only the beginning of the positive changes the program will affect in Rhode Island.

In the next five years, Seemann said, "you will see some bigger and even more exciting things."

Rhode Island's collaborative research network is represented by the state's two standing governance and advisory committees:

RI Science and Technology Advisory Council (STAC) provides oversight and governance for the program. Its Governor-appointed membership includes key leadership from government, local industry and institutions of higher learning. STAC ensures that EPSCoR-funded programs are integrated and aligned with the state's research infrastructure and economic development objectives.

RI EPSCoR Advisory Council serves in an advisory capacity to the RI EPSCoR program and STAC. The Council is composed of individuals representing all 11 Rhode Island institutions of higher education who have expertise in life-science research, K-16 education initiatives and workforce development.

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